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Palaeo-environments of the Balkan Lateglacial and their potential – were humans absent from the Garden of Eden?

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ABSTRACT

The lower part of a sediment core taken from the Ezero lake, next to Tell Ezero, in the Thracian Plain, Bulgaria, covers the period 15500–13500 calBP (Greenland Ice Core Stages G1-1c–1e). The recovery of plant macrofossils as well as pollen grains indicated that, far from a largely treeless grassy steppe vegetation, there were stands of trees and bushes as well as a rich wetland flora. Archaeological, ethnographic and ethnohistoric investigations of over 70 plant taxa showed that 20 taxa had documented use exclusively for food, 14 for exclusively medicinal use and 14 for both uses; moreover, several taxa were utilised or present in coeval sites such as the Franchthi Cave and in southwest Germany. The presumption is that Final Palaeolithic communities in the Thracian Plain would have made good use of such a rich supply of food and medicinal plants. However, there is a variety of reasons – whether taphonomic, research led or pedagogical – for the current absence of any Final Palaeolithic sites in the Thracian Plain. A hypothetical mating network centred on Ezero puts this problem in spatial context.

KEYWORDS

Final Paleolithic, Bulgaria, food, medicine, pollen, Ezero, plant macrofossils, mating networks

Introduction

In this contribution, our aim is to reconstruct the palaeo-environment of one part of South-east Europe – the Maritsa valley of southeast Bulgaria – as derived from recent study of pollen and macrobotanical remains (Chapman et al. 2009; Magyari et al. 2008). Our key question is whether or not local environments could have supported permanent or seasonal, long-term or short-term human settlement in the Maritsa basin, for which direct evidence is, as yet, lacking. In the EU-funded Project – ‘Climatic and anthropogenic drivers in the Holocene vegetation development of two large European river basins: the Maritsa valley in Bulgaria and NW Turkey and the Tisza valley in E Hungary’ (MEIFT-CT-2003-500501), two pollen cores were taken from the Ezero marsh adjoining the well-known archaeological monument Dipsiska mogila – a tell settlement dating to the Neolithic, Chalcolithic and Early Bronze Age (Georgiev et al. 1979; Dennell 1978) (Figs. 1–3). Although seasonal drying-out of the lake coeval with the occupations on the tell prevented sediment accumulation in the Middle Holocene period, there was excellent pollen preservation for the Upper Pleistocene and the Lateglacial parts of the Ezero-2 core, dated by six ¹⁴C dates to 15,500–13,500 cal BP

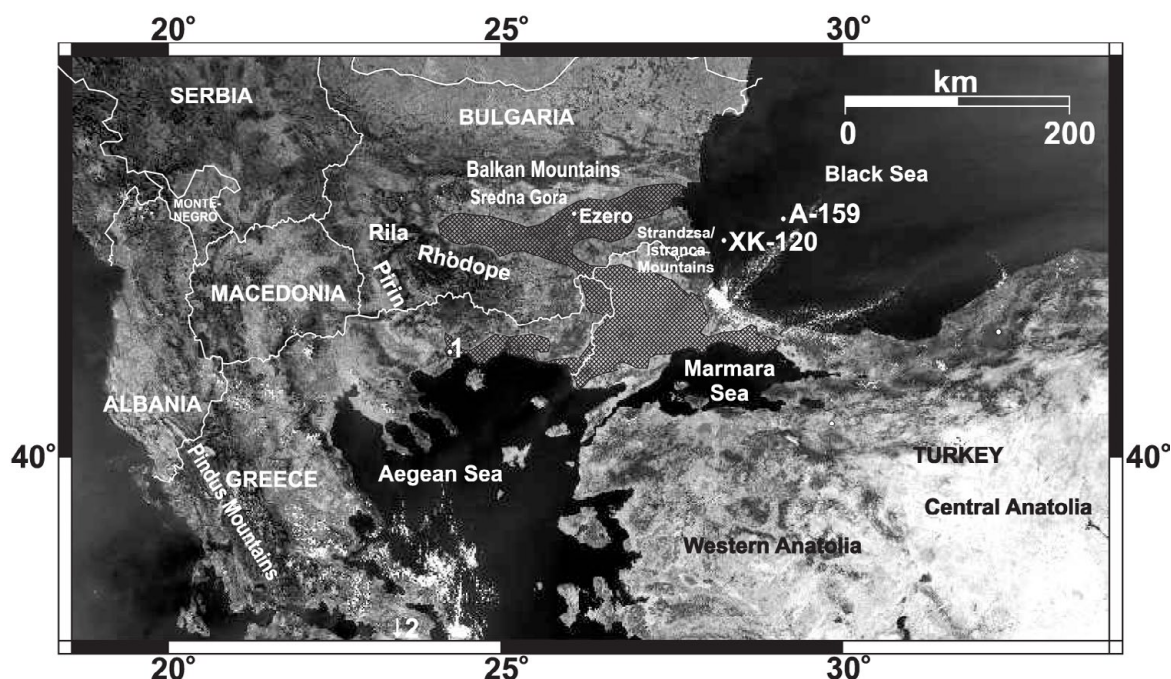


Fig. 1 Satellite remote-sensed image of south-east Europe. Geographical features referred to in the text are labelled, and the locations of the Ezero wetland and Franchthi Cave are noted (2). The area of the Thracian Plain is cross-hatched. [White areas, notably over the south-west Black Sea, where they form striking linear features, are clouds. Image modified from a full-colour MODIS (Moderate Resolution Imaging Spectroradiometer) image obtained on 21 September 2003 by the sensor onboard the Aqua satellite and downloaded from

<http://www.visibleearth.nasa.gov>

Обр.1. Сателитна снимка на югоизточна Европа. Маркирани са географските особености споменати в текста, както и местоположението на Езеро и пещерата Франхти (2). Горнотракийската низина е заштрихована. [Белите петна видими най-вече върху югозападното Черноморие, където те формират впечатляващи линейни формирования, са облаци. Образът е модифициран от цветна MODIS снимка, направена на 21.09.2003 от сензор на борда на сателит Аква и може да бъде намерен на адрес:

<http://www.visibleearth.nasa.gov>

(Magyari et al. 2008) (Table 1), as well as the Late Bronze Age and Iron Age (Chapman et al. 2009). The Ezero core can thus contribute to two important lines of evidence towards Upper Pleistocene and Late-glacial settlement and lifeways – the reconstruction of the local and regional environment and its provision of edible resources, both mobile and plant-based; and insights into the wide range of wetland and dry-land plants that would have been available to any foragers present in the region.

The Lateglacial record of the Ezero area is, in effect, a microcosm of the Final Palaeolithic of Southeast Europe. Despite the apparently considerable potential for human presence, extensive fieldwalking along the lines of new railway lines and motorways in this region has so far failed to reveal any traces of Final Palaeolithic lithics (Nikolov et al. 2006). Our approach to the issue of Lateglacial human settlement is therefore based upon the results of the Ezero pollen and plant macrofossil records. Were humans genuinely lacking from the region at the time, perhaps due to a resource base that was incapable of carrying

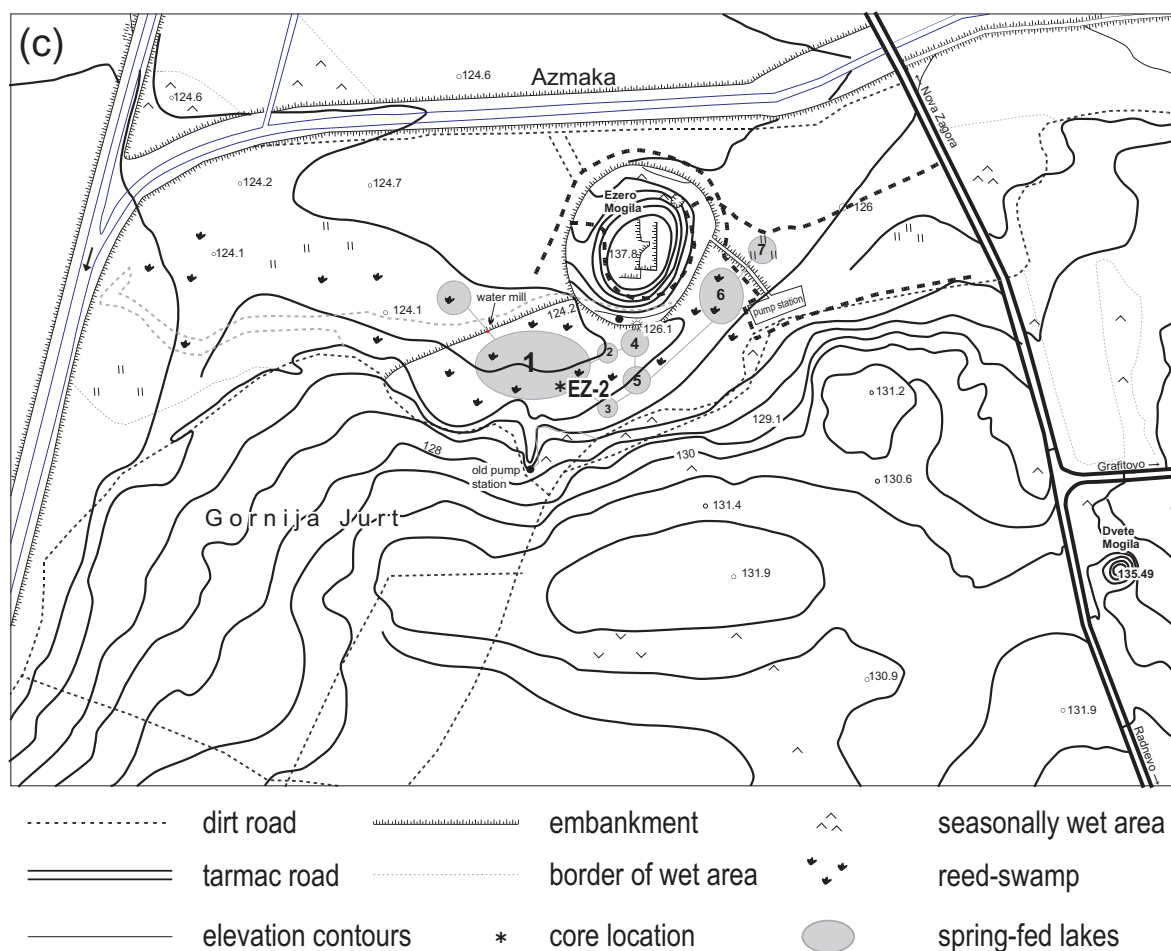


Fig. 2 Location map of the study site: Local features and relief in the immediate Vicinity of the Ezero wetland; Ezero-Dipsis is the tell that has been the subject of archaeological investigations

Обр.2. Местоположение на изследвания район. Релеф и особености на местната околна среда вкл. Дипсиска селищна могила (Езеро)

them? Or is their current invisibility due to sampling factors? In order to address these questions we first turn to a summary of the results of the pollen and macrofossil evidence from the Ezero core, before considering the potential usage of the plant taxa present in its Lateglacial layers both for food and medicine. We then set these results in the context of previous research into Final Palaeolithic diet before discussing the principal archaeological question – in such a rich and productive environment, why are so few Final Palaeolithic sites known in southeast Balkans?

The Ezero Core

Detailed pollen, macrofossil and molluscan analyses of organic deposits provide new insights into Lateglacial environmental change in the Thracian Plain in SE Bulgaria (Magyari et al. 2008) (Figs. 4–5). In the study area – the Ezero wetland – spring-fed lakes formed during the Upper Pleniglacial and accumulated sediment throughout the Lateglacial. Radiocarbon dating of terrestrial plant macrofossils confirmed that sediment accumulation



Fig. 3 Photograph of Ezero wetlands taken from the tell, July 2005 (photo John Chapman)

Обр.3. Снимка на езерото от могилата през юли 2005 (снимка Джон Чапман)

Depth (cm)	Material dated	Weight (g)	Laboratory sample code	Age measurement (^{14}C bp)	Calibrated age range BP
50–52	Wood charcoal fragments	12.03	Poz-1931	110.6 ± 0.5	Modern
165–167	Monocotyledon leaf fragments	2.54	Poz-1932	1315 ± 35	1290–1220
260–265	<i>Sambucus ebulus</i> seed fragments	2.71	Poz-12215	2970 ± 30	3260–3000
287–289	Wood fragments	7.24	Poz-1933	3000 ± 35	3330–3070
340–345	Monocotyledon leaf fragments	0.83	Poz-13602	8060 ± 50	9130–8760
390–393	Various macrofossils (> 180lm)	2.59	Poz-2734	$11,750 \pm 60$	14,060–13,440
420–425	Monocotyledon leaf fragments	2.43	Poz-13603	$12,390 \pm 60$	14,850–14,100
460–465	Monocotyledon leaf fragments	0.91	Poz-13604	$10,000 \pm 50$	11,710–11,260
510–515	Monocotyledon leaf fragments	1.98	Poz-13605	$12,930 \pm 60$	15,600–15,000
547–549	Bulk sediment	25.71	Poz-1934	$13,030 \pm 70$	15,800–15,050
576–579	<i>Celtis</i> fruit stones	2.01	Poz-12190	$12,900 \pm 60$	15,550–14,950

Table 1. Accelerator mass spectrometry ^{14}C age estimates obtained from Ezero wetland core EZ-2. List of ^{14}C dates for the Lateglacial part of the Ezero core

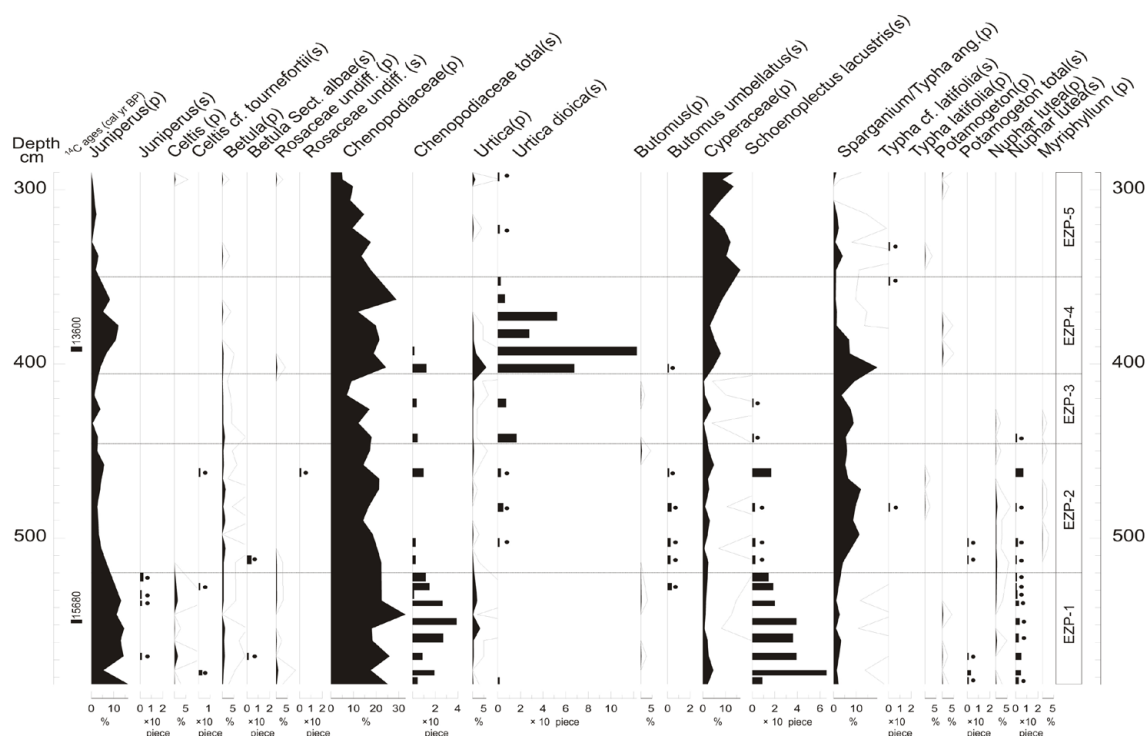


Fig. 4 Composite pollen and plant macrofossil diagram of selected taxa from the Lateglacial part of Ezero-2. Seeds with low representation are marked by black dots to emphasize their occurrence.

Pollen types are marked with (p), seeds by (s) after the taxon name

Обр. 4. Комбинирана диаграма (полен и макрофосили) на избрани видове от късно ледниковата част на поленовата колонка Езеро-2. Слабо представените семена са маркирани с черна точка с цел да се подчертае тяхното присъствие. Поленовите видове са маркирани с помощта на (p), а семената с (s) след името на съответния вид

was continuous and rapid between 15,500 and 13,500 cal BP in the Ezero basin (Fig. 4). The botanical record shows that, during the oldest dryas and early part of GI-1e (pollen zones EZP-1 and 2: 15,450–14,650 cal BP), the area supported continental, semi-desert like steppe vegetation formed by chenopods (Chenopodiaceae), wormwood (*Artemisia*), grasses (Poaceae) and with the scattered occurrence of drought-resistant trees/shrubs. The recovery of macrofossils of *Celtis tournefortii* type, *Juniperus* cf. *J. excelsa*, and a shrubby Rosaceae species confirmed that trees and shrubs occurred in the landscape and were probably more widespread than would be assumed on the basis solely of the pollen record. It has been argued that the vegetation cover was sparse and the lake was characterised by well-expressed seasonal water level fluctuations. At the core location, a lake existed and supported swamp vegetation on its shore formed by *Schoenoplectus lacustris*. Floating mats of *Nuphar lutea* were also common.

During the entirety of GI-1e (pollen zone EZP-3: c. 14,650–14,150 cal BP), a shift towards wormwood and grass dominance and organic-rich sediment accumulation were recorded, but there was no evidence for afforestation. As the Lateglacial got underway grass steppes spread from c. 14,650 cal BP, suggesting improved moisture availability. At the same time, the lake became overgrown by reed swamp. The increasing discharge of the Azmak river together with the regional spread of pines and junipers from c. 14,150 cal BP (Phase

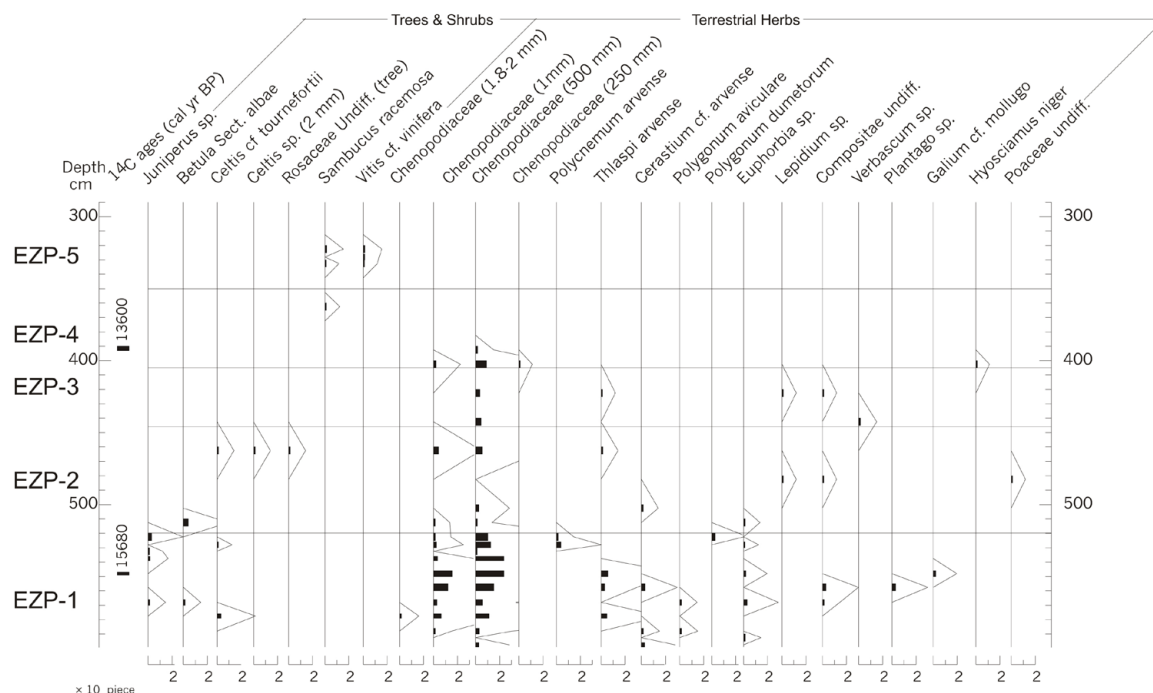
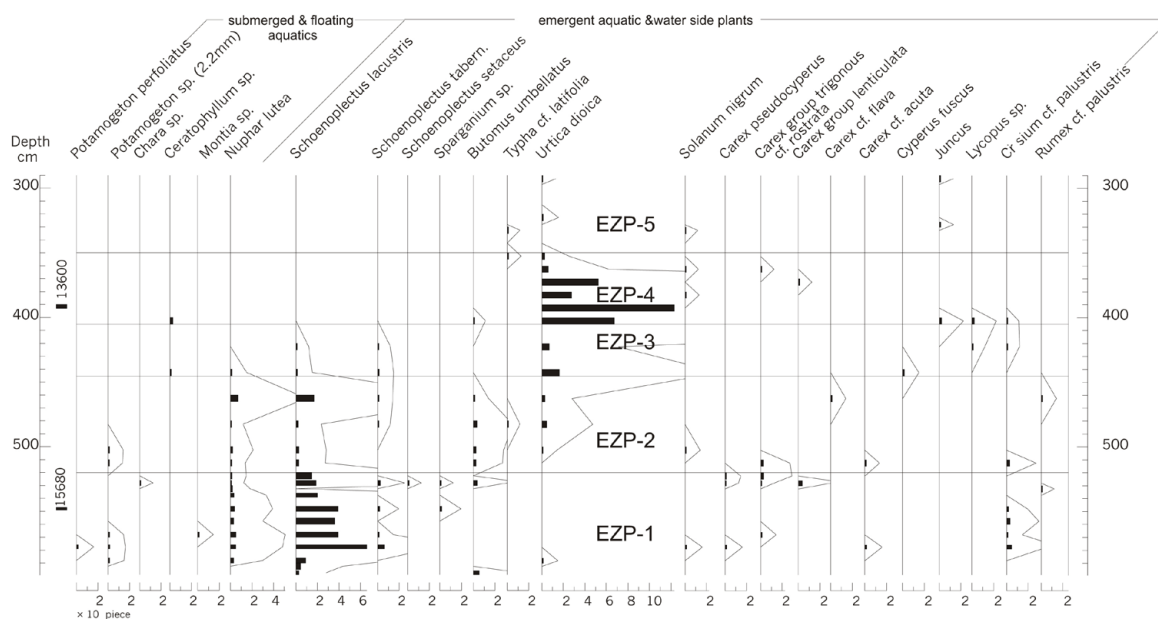


Fig. 5.a. Macrofossil diagram of the Lateglacial part of Ezero-2. Aquatic and wetland seeds.
Обр. 5.a. Диаграма на макрофосилите от късно ледниковата част на поленовата колонка
Езеро-2. Водни и влаголюбиви семена

Fig. 5.b. Macrofossil diagram of the Lateglacial part of Ezero-2. Terrestrial seeds
Обр. 5.b. Диаграма на макрофосилите от късно ледниковата част на поленовата колонка
Езеро-2 Сухоземни семена



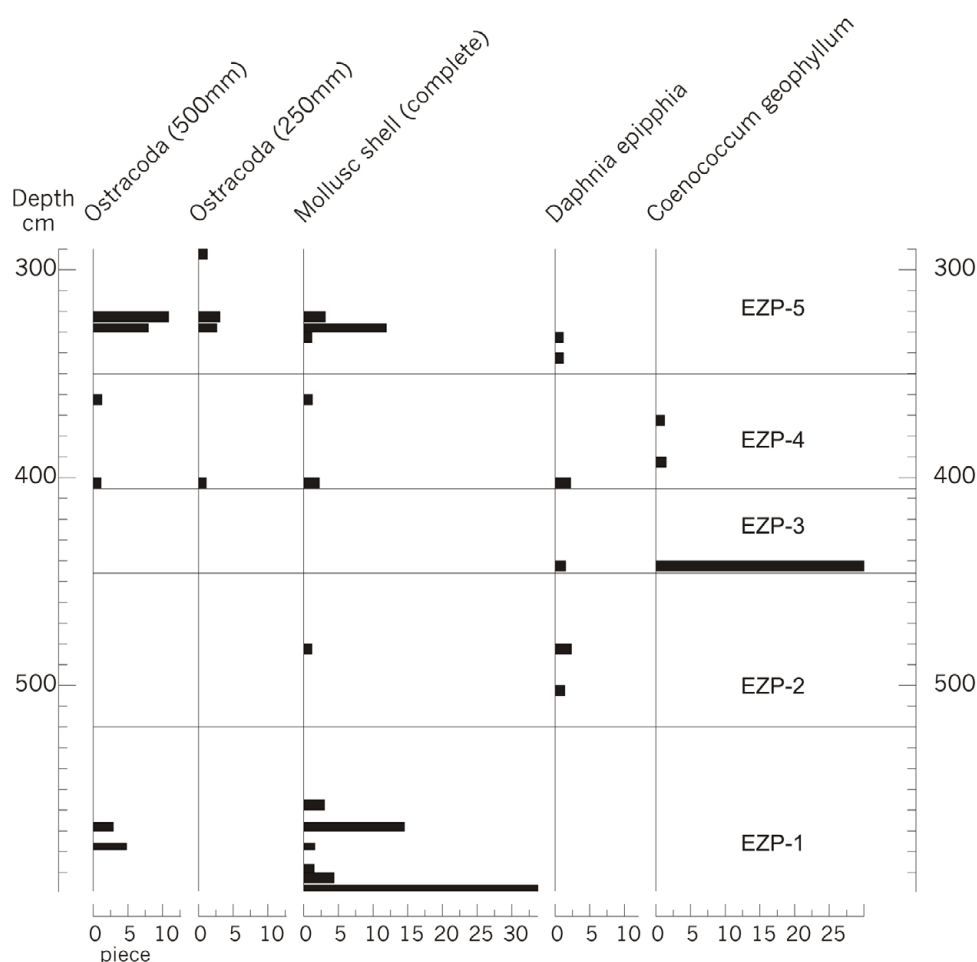


Fig. 5.c. Macrofossil diagram of the Lateglacial part of Ezero-2. Animal and fungal components
Обр. 5.c. Диаграма на макрофосилите от късно ледниковата част на поленовата колонка
Езеро-2. Животински и гъбични компоненти

EZP-4) suggests increasing river activity and afforestation in the nearby hills and probably also in the lowland. The spread of stinging nettle (*Urtica dioica*) in the seasonally flooded wetland provided evidence for disturbed, nutrient-rich, exposed surfaces. It shows that *Ephedra* shrubs in the Ezero area replaced junipers, alongside the continued presence of pines and warm continental steppe vegetation c. 12,800 cal BP. The spread of *Ephedra* points to extremely dry conditions as one would expect of the Younger Dryas. Probably the most important outcome of the present study was the macrofossil evidence for scattered tree cover during the Upper Pleistocene and Lateglacial in the Thracian Plain. The recovery of seeds of *Celtis tournefortii* type, *Betula pendula* and wood remains of several shrubby Rosaceae (Rosaceae, Maloideae and Prunoideae), *Quercus* and *Fraxinus* highlighted the importance of plant macrofossil analysis since these species were poorly represented in the pollen record (cf. Fig. 4 with Figs. 5a and 5b). If pollen analysis had been used alone, the environmental reconstruction would have surely underestimated the tree population and its species composition in the area.

Plants available for human use at Ezero

The Ezero pollen diagram shows that the paradigm of ‘extensive treeless steppe vegetation in the lowlands of Southern Europe’ in the Upper Pleistocene and the Lateglacial (Connor et al. 2013) can no longer be sustained (Magyari et al. 2008, 15). The wider availability of trees and shrubs has a potentially significant effect on the range of plant resources available to hunter-gatherer communities in the Thracian Plain between 15,500 and 13,500 cal BP, even though no Final Palaeolithic sites are currently known in this region. The Ezero plant remains offer one way to evaluate the question of whether Final Palaeolithic settlement was likely to have been very low density, or indeed non-existent, in the Thracian Plain because of the markedly low availability of plant resources in these millennia, allied to the low carrying capacity of animals in such a vegetation zone.

The Ezero diagram reveals the presence of a surprisingly wide range of plant taxa of potential use to hunter-gatherers – a total of almost 50 species (Tables 2–7). Of this total, twenty taxa have exclusively food uses, fourteen have exclusively medicinal uses; and fourteen taxa have both uses. The total includes six species of edible roots and tubers (Table 2), seven species of edible stems and shoots among which three or four species have medicinal uses (Table 3), 14 species of edible young leaves and catkins, and medicinal uses for a further three species (Table 4), eight species of wild cereals including *Hordeum*, *Secale*, *Triticum* and *Avena*, as well as wild flax (Table 5), three species of nuts (hazel, beech and acorn) and nine species of edible fruits and/or nuts (Table 6). This makes a total of 33 taxa with dietary potential for Final Palaeolithic hunter-gatherers. Five species identified at Ezero have a particularly wide range of potential uses, as documented in ethnobotany and ethnohistory – *Betula pendula* and *B. pubescens* (silver and common birch), *Typha latifolia* (reedmace), *Schoenoplectus lacustris* (bulrush) and *Nuphar lutea* (yellow water-lily).

The edible parts of *Betula pendula* and *B. pubescens* comprise the flowers, the inner bark, the leaves and the sap. The inner bark can be cooked or dried and ground into a meal (Hedrick 1972; Bryan, Castle 1976; Tanaka 1976). It can be added as a thickener to soups or can be mixed with flour for making bread and biscuits. Inner bark is generally only seen as a famine food, used when other forms of starch are not available or are in short supply (Johnson n.d.; Kunkel 1984). Sap can be consumed either raw or cooked. It is harvested in early spring, before the leaves unfurl, by tapping the trunk. With its sweet flavour, it makes a pleasant drink (Johnson n.d.). It is known to be often concentrated into a syrup by boiling off the water (Hedrick 1972; Triska 1975; Bryan, Castle 1976; Kunkel 1984). Between 4 and 7 litres can be drawn off a mature tree in a day and this will not kill the tree so long as the tap hole is filled up afterwards (Johnson n.d.). However, prolonged or heavy tapping will kill the tree (Johnson n.d.). The flow is best on sunny days following a frost. The sap can be fermented into a beer. An old English recipe for beer is as follows:- ‘To every Gallon of Birch-water put a quart of Honey, well stirred together; then boil it almost an hour with a few Cloves, and a little Limon-peel, keeping it well scummed. When it is sufficiently boiled, and become cold, add to it three or four Spoonfuls of good Ale to make it work...and when the Test begins to settle, bottle it up . . . it is gentle, and very harmless in operation within the body, and exceedingly sharpens the Appetite, being drunk ante pastum.’ (Johnson n.d.). Young leaves can be consumed either raw or cooked, as can young catkins (Bryan, Castle 1976). A tea can be made from the leaves (Bryan, Castle 1976; Yanovsky 1936) and another tea is made from the essential oil in the inner bark.

The edible parts of *Typha latifolia* consist of flowers, leaves, pollen, root, seed and

stem. The roots can be consumed either raw or cooked (Hedrick 1972). They can be boiled and eaten like potatoes or macerated and then boiled to yield a sweet syrup. The roots can also be dried and ground into a powder, this powder is rich in protein and can be mixed with wheat flour and then used for making bread, biscuits and muffins. One hectare of this plant can produce 8 tonnes of flour from the rootstock. The plant is best harvested from late autumn to early spring since it is richest in starch at this time (Johnson n.d.). The root contains about 80% carbohydrate (30–46% starch) and 6–8% protein. The young shoots in the spring can be eaten either raw or cooked (Johnson n.d.), as an asparagus substitute, tasting like cucumber. The shoots can still be used when they are up to 50cm long. The base of the mature stem can be consumed either raw or cooked (Hedrick 1972). It is best to remove the outer part of the stem. One English folk name is 'Cossack asparagus' (Johnson n.d.). The immature flowering spike can be eaten either raw, cooked or made into a soup. It tastes like sweetcorn. The seed can be eaten either raw or cooked (Hedrick 1972). The seed is rather small and fiddly to utilize, but has a pleasant nutty taste when roasted. The seed can be ground into a flour and used in making cakes. An edible oil is obtained from the seed. Due to the small size of the seed, this was not regarded as a very worthwhile crop. The pollen can be eaten either raw or cooked, whether as a protein rich additive to flour when making bread and porridge (Johnson n.d.) or with the young flowers, which makes it considerably easier to utilize. The pollen can be harvested by placing the flowering stem over a wide but shallow container and then gently tapping the stem and brushing the pollen off with a fine brush. This will help to pollinate the plant and thereby ensure that both pollen and seeds can be harvested.

The edible parts of *Schoenoplectus lacustris* consist of the leaves, the pollen, the root, the seed and the stem. The root can be consumed either raw or cooked (Hedrick 1972). Rich in starch, it can be dried and ground into a powder or made into a syrup (Triska 1975). The buds at the end of the rhizomes are crisp and sweet, making excellent eating raw. The young shoots can be eaten either raw or cooked, being used in spring. The seed can be ground up into a powder and mixed with flour for use in making cakes. The seed is small and rather fiddly to harvest and utilize. The base of the mature stems can be eaten either raw or cooked, although somewhat tough. The pollen can be consumed either raw or cooked. Rich in protein, it is mixed with flour and used in making cakes.

The edible parts of *Nuphar lutea* constitute the leaves, the root and the seed. The root can be cooked (Hedrick 1972; Kunkel 1984) to extract an edible starch for use as a possible emergency food. The root has a bitter flavour, which can be removed by leaching the root in water. The leaves and leaf stalks can be cooked (Hedrick 1972; Kunkel 1984), as can the seed (Tanaka 1976). It can be ground into a powder and used in making bread and porridge, or for thickening soups. The seed can also be parched, when it swells considerably but does not burst like popcorn. It is then normally eaten dry. A refreshing drink can be made from the flowers (Hedrick 1972).

The general pattern of potential plant use relies on the five-stage chronology of the Ezero diagram (Tables 2–6). The numbers of examples of each plant represented either as a pollen grain or as a plant macrofossil are so small that it is risky to rely too much on minor changes in frequencies. Nonetheless, some strong patterning is evident, enough to suggest that many of the taxa identified at Ezero were present in all of the five phases of the diagram – and thus continuously during the Lateglacial – indicating a relative stability of resource availability for some two millennia.

This continuous pattern is least evident for edible roots and tubers (Table 2), no taxon

Taxon	Nutritional value	Zones of Ezero pollen & plant macrofossil diagrams where taxa present				
		EZP – 1: 500-620 cm	EZP – 2: 500- 446 cm	EZP – 3: 446-405 cm	EZP – 4: 405-350 cm	EZP – 5: 350-290 cm
		15450 15200 cal BP	15200 – 14650 cal BP	14650 – 14150 cal BP	14150 – ? cal BP	?-? cal BP
<i>Typha latifolia</i> (reedmace)	Some P; High in C; some S	-	X(S)-	X(S)-	-	X (P) XX (S)
<i>Typha angustifolia</i> (small reedmace)	Some P; High in C; some S	-	XX(P)-	XXX(P)-	XX(P)-	X (P)
<i>Schoenoplectus lacustris</i> (bulrush)	High in C	XX X(S)	XX (S)	X (S)	-	-
<i>Nuphar lutea</i> (yellow water lily)	High in C	XXX (P+S)	XXX(P+S)	XX (P+S)	-	-
<i>Potamogeton perfoliatus</i> (pondweed)	High in C	XX (P) X(S)	-	-	XX (P)	X (P)
<i>Butomus umbellatus</i> (flowering rush)	High in C	XX (P+S)	XXX (P+S)	XX (P+S)	X (S)	-

Key to Tables 2 – 6: nutritional value – P – proteins; F – fats; C – carbohydrates; S – starch; V – vitamins; distribution of plants: X – one case; XX – 2 – 3 cases; XXX – 4+ cases; P – pollen grain; S – seed / macro-fossil

Table 2. Edible tubers and roots, Lateglacial part of the Ezero core

of which is found in all five phases of the diagram. Nonetheless, the flowering rush, bulrush and water lily were found in three or more phases, suggesting consistent presence of these resources in the Ezero lake. A slight trend of decreasing frequency of taxa with time may be evident in these edible species that offered dietary breadth rather than the potential for staple foods. In terms of seasonal availability, only two species (both of reedmace) could produce edible rhizomes in the winter months.

The availability of stems and shoots (Table 3) reveals a far more continuous presence than the tubers and roots, with three edible taxa (nettle, marsh-thistle and Scots pine) and three taxa with medicinal uses (willow, sea grape and nettle) present in all five pollen phases. The remaining species could also have been used for their edible roots and tubers, although have more discontinuous distributions than the other taxa. Stems and shoots could have been used at various seasons, as dietary supplements rather than major food staple elements.

A long list of taxa whose young leaves and catkins offered spring and early summer foodstuffs of some variety are present (Table 4), and a large number of these (bedstraw, knotweed, bindweed, nettle, black nightshade, sorrel, yarrow and elm) have medicinal use. Six of such taxa are present in every phase of the Ezero diagram (bedstraw, goosefoot, nettle, yarrow, birch and elm), while the black nightshade is found in four phases and four other taxa in three phases. This distribution suffices to suggest that the bulk of these seasonal foods were available over the full two millennia of the Ezero diagram, as useful and

Taxon	Nutritional value	Phases of Ezero pollen diagram where taxa present				
		EZP – 1	EZP - 2	EZP – 3	EZP - 4	EZP – 5
<i>Urtica dioica</i> (nettle)	Some P; high in C; high on V	XX (P+S)	XX (P+S)	XXX (P+S)	XXX (P+S)	XX (P+S)
<i>Cirsium palustre</i> (marsh-thistle)	Low in C	XXX (P+S)	XXX (P+S)	X (S)	XX (P)	XX (P)
<i>Pinus sylvestris</i> (Scots pine)	Inner bark low in C	XXX (P)	XXX (P)	XXX (P)	XXX (P)	XXX (P)
<i>Typha latifolia</i> (reedmace)	Some P; High in C; some S	-	X(S)-	X(S)-	-	X (P) XX (S)
<i>Typha angustifolia</i> (small reedmace)	Some P; High in C; some S	-	XX(P)-	XXX(P)-	XX(P)-	X (P)
<i>Schoenoplectus lacustris</i> (bulrush)	High in C	XX X(S)	XX (S)	X (S)	-	-
<i>Potamogeton perfoliatus</i> (clasped pondweed)	High in C	XX (P) X(S)	-	-	XX (P)	X (P)

Key to Tables 2 – 6: nutritional value – P – proteins; F – fats; C – carbohydrates; S – starch; V – vitamins; distribution of plants: X – one case; XX – 2 – 3 cases; XXX – 4+ cases; P – pollen grain; S – seed / macro-fossil

Table 3. Stems and shoots, Lateglacial part of the Ezero core

tasty salads and soups in the mid-year.

The Lateglacial presence of four species of wild cereals (Table 5) is particularly interesting in the periods concerned, even though the pollen cannot be identified to species. The discovery of wheat, barley, oats and rye in the period 15,500–13,500 cal. BP indicates the wealth and diversity of the local Lateglacial flora in the south Balkans, with the obvious comparandum being the consumption of wild barley at Upper Palaeolithic Franchthi Cave (Hansen 1991). Occasionally, the individual pollen grains can be identified to genera; in other cases, the size of the wild grasses, at over 40µm, defines them as this sub-set of wild cereal taxa. A fifth useful wild plant present is flax, which, among other plants such as nettles and tree bast, could have been used to make cordage; only one case of use of flax for cordage is noted, however. The smaller seeded grasses (goosefoot, the *Polygonum* species and pennycress) share the disadvantage of small size and fiddliness to use but can, nevertheless, contribute to the thickening of soups and stews. There appears to be a minor difference in the distribution of seed plants, with a more continuous distribution for the wild cereals and a more patchy distribution for the smaller-seeded grasses. The most likely usage of these wild cereals at Ezero would have been as small-scale sources of carbohydrates. Given their apparently low volume, however, it seems unlikely that storage was possible on the scale that would have permitted the intensification of gathering of wild cereals to the point that they became a food staple.

A range of nine berries and three nuts, mostly available in summer and early autumn, were recovered at Ezero (Table 6), with five taxa identified in every phase (Jerusalem thorn, sea grape, elm and oak; although juniper-like pollen was found in each phase, the more specific Grecian juniper with its edible fruit was found in only one phase). The hackberry is well known from early contexts in Anatolia (Magyari et al. 2008, 14), as well as from the Upper Palaeolithic at Franchthi Cave (Hansen 1991). All of these taxa could have provided additional tasty elements to a late-year diet, without any notion of food staples, although

Taxon	Nutritional value	Phases of Ezero pollen diagram where taxa present				
		EZP – 1	EZP – 2	EZP – 3	EZP - 4	EZP – 5
<i>Galium</i> sp. (bedstraw)	Low in C	XXX (P+S)	XX (P)	XX (P)	XX (P)	X (P)
<i>Chenopodium</i> sp. (goosefoot)	High in P; some V	XXX (P+S)	XXX (P+S)	XX (P+S)	XXX (P+S)	XX (P)
<i>Polygonum dumetorum</i> (copse bindweed)	Small seeds with some C: fiddly to utilize	X(S)				
<i>Polygonum aviculare</i> (knotweed)	Small seeds with some C: fiddly to utilize	XX (P+S)	-	X (P)	-	X (P)
<i>Thlaspi arvense</i> (pennycress)	Some minerals	XX (S)	X (S)	X (S)	-	-
<i>Solanum nigrum</i> (black nightshade)	Leaves high in V but slightly toxic	X (S)	X (S)	-	XX (S)	X (S)
<i>Urtica dioica</i> (nettle)	Some P; high in C; high on V	XX (P+S)	XX (P+S)	XXX (P+S)	XXX (P+S)	XX (P+S)
<i>Rumex</i> sp. (sorrel)	High in P; high in C; some V	XX (P+S)-	XXX (P+S)	X (P)	-	-
<i>Achillea</i> sp. (yarrow)	Leaves for tea, some P	XX (P)	XX (P)	X (P)	X (P)	X (P)
<i>Typha latifolia</i> (reedmace)	Flowers + some P; High in C; some S	-	X(S)-	X(S)-	-	X (P) XX (S)
<i>Typha angustifolia</i> (small reedmace)	Flowers + some P; High in C; some S	-	XX(P)-	XXX(P)-	XX(P)-	X (P)
<i>Schoenoplectus lacustris</i> (bulrush)	Flowers high in C	XX X(S)	XX (S)	X (S)	-	-
<i>Betula pendula</i> (silver birch) & <i>pubescens</i> (common or downy birch)	young leaves and catkins cooked + sap (sugary liquid) rich in P; inner bark + S	XXX (P+S)	XXX (P+S)	XX (P+S)	XX (P)	X (P)
<i>Ulmus</i> sp. (elm)	Bark high in P; young leaves as salad, rich in V	X (P)	XX (P)	X (P)	XX (P)	XX (P)

Key to Tables 2 – 6: nutritional value – P – proteins; F – fats; C – carbohydrates; S – starch; V – vitamins; distribution of plants: X – one case; XX – 2 – 3 cases; XXX – 4+ cases; P – pollen grain; S – seed / macro-fossil

Table 4. Young leaves and catkins, Lateglacial part of the Ezero core

there was the possibility of storage of acorns and hazelnuts.

Twenty-eight species were identified as having potential medicinal significance (Table 7) (Lewis, Elvin-Lewis 1977). Although most of these are documented as having been used in folk medicine in the Late Medieval and/or Early Modern period, evidence for the earlier utilization of some species exists, e.g. the use of different parts of the willow by the ancient Greeks as painkillers (Lewis, Elvin-Lewis 1977, 150). A recurrent pattern in Table 7 is that certain conditions could be treated with at least two different species. For instance, five species can be used as laxatives and/or purgatives, while five species can be used to relieve toothache, and among the taxa present are at least four remedies for itches and skin-related

Taxon	Nutritional value	Phases of Ezero pollen diagram where taxa present				
		EZP – 1	EZP – 2	EZP – 3	EZP – 4	EZP – 5
<i>Hordeum</i> (barley)*	High in C	X (P)	X (P)	X (P)	XX (P)	XX (P)
<i>Secale</i> (rye)	High in C	X (P)	XX (P)	-	X (P)	-
<i>Triticum</i> (wheat)*	High in C	X (P)	X (P)	X (P)	XX (P)	XX (P)
<i>Avena</i> (oats)*	High in C	X (P)	X (P)	X (P)	XX (P)	XX (P)
<i>Chenopodium</i> sp. (goosefoot)	High in C	XXX (P+S)	XXX (P+S)	XX (P+S)	XXX (P+S)	XX (P)
<i>Polygonum dumetorum</i> (small and fiddly to utilize)	Small seeds with some C: fiddly to utilize	X(S)-	-	-	-	-
<i>Thlaspi arvense</i> (pennycress)	Some minerals	XX (S)	X (S)	X (S)	-	-
<i>Polygonum aviculare</i> (small and fiddly to utilize but can substitute for buckwheat)	Small seeds with some C: fiddly to utilize	X (P+S)	-	X (P)	-	X (P)
<i>Linum</i> (flax)		-	-	X (S)	-	-

*only a cumulative Gramineae (>40 micron) curve is shown in the pollen diagram

Key to Tables 2 – 6: nutritional value – P – proteins; F – fats; C – carbohydrates; S – starch; V – vitamins; distribution of plants: X – one case; XX – 2 – 3 cases; XXX – 4+ cases; P – pollen grain; S – seed / macro-fossil

Table 5. Seeds, Lateglacial part of the Ezero core

diseases. Such an abundance of medicinal potential suggests that, when available, at least some, if not all of those species could have been utilized for medicinal purposes. We may even take the argument further by suggesting that the use of different remedies varied seasonally depending on their availability. It is noteworthy that only a few of the species can be used to relieve pain, while more are used for healing, preventative care and procedures of stimulation. There are also selected cases of plants effective in the possible treatment of single conditions, such as childbirth, dysentery, urinary and bladder ailments.

In summary, the plant taxa identified in the Lateglacial section of the Ezero pollen and plant macrofossil diagrams would have been available to any groups of hunter-gatherers present in the region for use as dietary supplements in spring, summer and autumn. The key group for spring and early summer would have been the young leaves and catkins, with some of roots and tubers also in season at the time. Later in the year, stems and shoots would have preceded seeds and fruits. Very few species would have filled the long winter shutdown, however, reedmace being an exception. In addition, there is a narrow range of taxa with secondary subsistence uses, such as the rushes that would have been useful if constructing reed shelters, *Potamogeton* that attracts waterbirds and *Euphorbia* that provides good animal fodder.

The actual nutritional usefulness of the plant spectrum at Ezero would of course have depended upon the actual range (i.e. variability) of plant taxa actually utilised. If the majority of plant taxa were indeed collected by hunter-gatherers, a nutritionally well-balanced diet could have been achieved. From a nutritional point of view the weakness of the spectrum is the small number of taxa – only the nuts-providing fats.

As there is no evidence for a strong concentration of wild cereal pollen or macrofossils

Taxon	Nutritional value	Phases of Ezero pollen diagram where taxa present				
		EZP – 1	EZP - 2	EZP – 3	EZP – 4	EZP – 5
<i>Celtis tournefortii</i> (oriental hackberry)	Fruit high in C, with some P & V	XXX (S+P)	X (S)	-	-	X (P)
<i>Juniperus excelsa</i> (Grecian Juniper)	Fruit edible raw and cooked, high in C, with some P & V	XX (S)	-	-	-	-
<i>Juniperus</i> -like (juniper)	Fruit edible raw and cooked, high in C, with some P & V	XXXX (P)	XXX (P)	XXX (P)	XXX (P)	XXX (P)
<i>Paliurus spina-christi</i> (Jerusalem Thorn)(not shown in the pollen diagram!)	Small fruit edible either raw or dried, high in C, with some P & V	X (P)	XX (P)	X (P)	X (P)	X (P)
<i>Ephedra distachya</i> (Sea grape)	Fruit raw, sweet but rather insipid flavor, high in C, with some P & V	XXX (P)	XX (P)	X (P)	XX (P)	XXX (P)
<i>Ulmus</i> sp. (elm)	raw, immature fruits just after they formed, high in C, low in P & V	X (P)	XX (P)	X (P)	XX (P)	XX (P)
<i>Sambucus ebulus</i> (dwarf elder)	Berries slightly toxic, high in C, low in P & V	-	-	-	X (S)	XX (S)
<i>Vitis</i> (wild grape)	High in C, low in P & V	XX (P)	-	-	-	-
Rosaceae (Maloideae ad Prunoidae) (pears & plums)	High in C, some P & V	XX(wood)		-	-	-
<i>Quercus</i> spp. (oak)	Acorns high in F, some P and C and low in V	XX(wood)	X (P)	X (P)	X (P)	XXX (P)
<i>Corylus</i> -type (hazel)	Nuts high in F, low in C & P, some V	X (P)	X (P)	X (P)	XX (P)	X (P)
<i>Fagus sylvatica</i> (beech)	Nuts high in F, moderate in C, low in P, some V	-	-	-	-	X (P)

Key: nutritional value – P – proteins; F – fats; C – carbohydrates; S – starch; V - vitamins; distribution of plants: X – one case; XX – 2 – 3 cases; XXX – 4+ cases; P – pollen grain; S – seed / macro-fossil

Table 6. Fruits and nuts, Lateglacial part of the Ezero core

at Ezero, it would be extremely risky to suggest that there was any kind of reliance on these plant foods as important food sources or, even less probably, as food staples. The plants identified as potential food sources at Ezero represent a *broad-spectrum* range of foodstuffs, with *cumulative* value for the diet of any hunter-gatherers present in the region, in addition to which was a wide range of medicinal uses.

We have now established a baseline of potential Lateglacial plant food and medicinal

Name of species	Medicinal use(s)
<i>Urtica dioica</i> (nettle)	Diuretic; homeopathic treatment for skin diseases
<i>Polygonum dumetorum</i> (copse bindweed)	Laxative
<i>Polygonum aviculare</i> (knotweed)	Mild astringent
<i>Polygonum</i> spp.	Source of tannine in folk medicine
<i>Solanum nigrum</i> (black nightshade)	Strong sudorific, analgesic and sedative with powerful narcotic properties
<i>Galium</i> sp. (bedstraw)	Anticoagulant (<i>G. triflorum</i>); toothache (<i>G. bungei</i>); venereal diseases (<i>G. umbrosum</i>)
<i>Rumex</i> sp. (sorrel)	Laxative; tonic and alterative; astringent; skin pain and itching; for jaundice (<i>R. verticillatus</i>)
<i>Achillea</i> sp. (yarrow)	Eyewash; earache; itching
<i>Ulmus</i> sp. (elm)	Urinary tract inflammations; poultice for abscesses, boils (<i>U. fulva</i>) and burns (<i>U. campestris</i>)
<i>Typha latifolia</i> (reedmace)	Poultices for boils, burns or wounds
<i>Linum</i> (flax)	To remove foreign material from the eye (<i>Linum</i> spp.); purgative (<i>L. catharticum</i>); laxative (<i>L. usitatissimum</i>)
<i>Centaurea</i> (cornflower)	Tonic and stimulant
Cupressaceae (cypress family)	Toothache (<i>C. arizonica</i>)
<i>Plantago</i> (plantain)	Toothache (<i>P. media</i> and <i>P. major</i>); purgative (<i>P. psyllium</i> and <i>P. ovata</i>)
<i>Alnus</i> (alder)	Indigestion; tonic and alternative; emetic (<i>A. rubra</i> and <i>A. rugosa</i>); vaginal discharges and skin itching (<i>A. incana</i>); pain from burns and scalds (<i>Alnus</i> spp.);
<i>Salix</i> (willow)	General pain-killer; fever; toothpicks; sore eyes; removing bile from the stomach (<i>S. lucida</i>)
<i>Crataegus</i> (hawthorn)	Bladder ailments (<i>C. tomentosa</i>)
<i>Quercus</i> (oak)	Sore lips and mouth (<i>Q. alba</i>); source of tannine; astringent; dysentery (<i>Quercus</i> sp.); haemorrhoids (<i>Q. infectoria</i> and <i>Q. alba</i>)
<i>Fraxinus</i> (ash)	Haemorrhoids; sores and itches (<i>F. americana</i>)
<i>Anthemis</i>	Bee string (<i>A. cotula</i>)
<i>Senecio</i>	Easing childbirth and hastening labour (<i>S. aureus</i>); stimulant and tonic (<i>S. jacobaea</i>)
<i>Euphorbia</i>	Toothache; emetic and purgative; for diaphoresis and as expectorant
<i>Alisma plantago-aquatica</i>	Diuretic (<i>A. plantago</i>)
<i>Hyoscyamus niger</i>	Toothache
<i>Veronica</i>	Chronic skin diseases (<i>V. officinalis</i>)
<i>Stellaria media</i>	Itchiness, skin conditions
<i>Betula pendula</i> (silver birch)	Diuretic
<i>Pinus sylvestris</i> (Scots pine)	Antiseptic, diuretic, expectorant
<i>Ephedra distachya</i> (sea-grape)	Stimulant properties

Polygonum dumetorum= *Fallopia dumetorum*

Table 7. Medicinal uses of plants, Lateglacial part of the Ezero core

availability, based upon the Ezero pollen core and its plant macrofossils and a comparison of the uses of these taxa in ethnographic and historic contexts. In contrast to the previous model for the Lateglacial of the region of a shrubby steppe zone with low primary plant productivity (Connor et al. 2013) and thus low animal densities, we can now conceive of the palaeo-environment of the Thracian Plain as far more taxonomically diverse, much more akin to a nutritionally and medicinally viable ‘Garden of Eden’ than a shrubby steppe, of-

fering a remarkably wide range of available plants which have well-documented human use. How do the plant resources of the Thracian Plain compare with other regions where there is well-attested evidence for the diets of Final Palaeolithic settlements?

Palaeolithic diets: small animal and plant use

In the 1960s and 1970s, the selective investigation of sites with better conditions of organic preservation combined with the development of effective techniques for the recovery of plant and animal remains (flotation and screening) led to a revolution in the understanding of the subsistence aspects of economic prehistory (Dennell 1983; Barker 1985; Price 1989). Despite the rigorous application of these techniques in projects such as the excavation of the Klithi rockshelter (Greece), no charred plant remains were recovered (Bailey 1997, 664). Bailey lamented the under-representation of plant foods due to the poor conditions of preservation in rockshelters. The effect of this under-representation of plant foods is the prominence – if not *over*-representation – of animal protein contributions to the Lateglacial/Final Palaeolithic diet, whether ibex at Klithi (Gamble 1997; 1999b), caprovines, red deer, roe deer and wild boar at Öküzini Phases 2–3, Turkey (Otte et al. 1999, 82–84), chamois and ibex in the relatively poorly-preserved faunal assemblage of the Boila rockshelter in Northwest Greece (Kotjabopoulou et al. 1999), red deer, ibex and chamois during the Epigravettian occupation of Trebački Krš, northeast Montenegro (Dimitrijević 1999) or red deer at Badanj Cave, Bosnia (Whallon 1999). Which research strategies could be used to re-position the significance of plant or animal contributions to Final Palaeolithic and Lateglacial diet?

There are four obvious approaches to making a more balanced assessment of the significance of plant foods in Lateglacial diet: (1) the excavation of a range of sites with excellent organic preservation; (2) the more nuanced calibration of isotopic dietary signatures for better discrimination between terrestrial plants and animal sources of dietary protein; (3) ethnoarchaeological or ethnographic research into resource potential; and (4) a more explicit use of the major resource of pollen and plant macrofossil data (much of it available in the European Pollen Database) to reconstruct lists of plants available for use by prehistoric communities at specific times and places. Few Lateglacial sites offer excellent conditions of preservation and few isotopic dietary studies exist for the period. We now summarise these lines of evidence before turning to pollen and plant macrofossil records as a baseline for understanding the potential of plant utilization – whether for food or medicinal use – in the Lateglacial.

Unsurprisingly, evidence of the use of small animals and plants does exist for Southern European Lateglacial sites. Shellfish formed an important resource for Upper Palaeolithic groups of Portugal, their use varying with fluctuations in sea level (Bicho, Haws 2008; Bicho et al. 2011). Small animals including pond tortoise, ducks and fishes were recovered from Lateglacial levels of the Grotta Polesini near Rome, and pond tortoise, turtle and fishes in the Grotta dei Cervi in Levanzo, Sicily (Mussi 2001). The Younger Dryas deposits of the Arene Candide cave in Latium yielded carbonised seeds and fruits including hazelnuts (Cardini 1946). A comparable case shows the use of wild almonds at the Öküzini cave (Martinoli, Jacomet 2004). A classic example of the broad-spectrum use of an impressive variety of wild plant taxa by hunter-gatherers is the Lateglacial and early Holocene levels of Tell Abu Hureyra 1, Northern Syria, which date to 11,700–9000 cal BC (Moore et al. 2000). Before the sudden transition to farming documented at the tell, a total of over 140 wild plant species were used (with up to 50 more unidentified species), many of which have medicinal

uses as well as nutritional value (Hillman 2000, 369). Of the 142 species, fully 118 were used regularly for food. The Abu Hureyra results stand as a stark reminder that it is often the vagaries of preservation of organic remains, coupled with the recovery techniques deployed (or not) by archaeologists, that usually account for the wide variations in the taxonomic frequency and variability of plant foods represented on prehistoric sites.

A pioneering volume in this respect was Mason and Hather's (2002) collection of papers on hunter-gatherer archaeobotany. These documented a dozen cases of the widespread use of plant foods by hunter-gatherers prior to the spread of agriculture, and support the conclusions drawn from Tell Abu Hureyra – that 'hunter-gatherers utilised a wide range of plant species' (Hather, Mason 2002, 2). While Wohlgemuth (2002, 41) discussed the abundance of small seeds used by the Late Horizon communities in central California, the importance of root foods to groups living on the Canadian Plateau was emphasised by Peacock (2002). Excellent research on site formation processes has shown how plant foods came to be present in western North America (Lepofsky 2002) and in the Ertebølle of southern Scandinavia (Robinson, Harild 2002), while charcoal diagrams and the study of soft plant tissues revealed additional information (Zapata et al. 2002; Perry 2002).

Plant use, in fact, probably had a long history among the Palaeolithic hunter-gatherers of Europe. Although isotopic analysis of Neanderthal remains overwhelmingly points to the importance of meat as the source of their dietary protein (Richards, Trinkaus 2009), it is clear that hunting occurred within the context of varied and regionally diverse economies in which small terrestrial, aquatic, marine and plant resources played a role. Carbonised plant remains reveal that Neanderthals were eating pine nuts at Gorham's and Vanguard caves, Gibraltar (Gale, Carruthers 2000) and acorns and pistachio nuts at Kebara Cave, Israel (Lev et al. 2005). At the Abric Romani, Spain, they were gathering pine wood for fire and were working juniper wood (Carbonell et al. 1996). As Neanderthals were clearly capable of exploiting small animals such as shellfish, birds and tortoises (e.g. Stiner 1993; Barton 2000; Fiore et al. 2004; Stringer et al. 2008; Finlayson et al. 2012), it is not surprising that lithic residue and use-wear analysis from Middle Palaeolithic sites suggest that they were processing birds, fish and starchy plants as early as the late Middle Pleistocene (Hardy, Moncel 2011), and that plant microfossils trapped in dental calculus on Neanderthal teeth reveal that they were using medicinal plants c. 50,000 BP at El Sidrón, Spain (Hardy et al. 2012). A similarly long list of plant taxa from the Mid Upper Palaeolithic site of Avdeevo on the Russian Plain was published by Dolukhanov (2002, 182), without, however, any assessment of the food or medicinal usage of these plants. Strach grains from the Mid Upper Palaeolithic sites of Kostenki XVI (Uglyanka) Russia, Bilancino II, Italy and Pavlov VI, Czech Republic, show that the processing of plant materials at these sites included the production of flour, and thus that it may have been a widespread practice from at least 32,000 cal BP (Revedin et al. 2010).

Low $\delta^{15}\text{N}$ values of human remains from the Azilian of the Lateglacial Interstadial levels of Balma Guilanyà, Spanish Pre-Pyrenees, have been taken to suggest a plant-based protein element in a terrestrial diet, which is supported by the recovery of pine and hazelnut charcoal (Garcia-Guixé et al. 2009). A degree of dietary diversity is evident in the Final Palaeolithic of Sicily, where isotope analysis of human remains from the Grotta Addaura suggest that red deer were the main source of protein but shellfish played a minor role, whereas by contrast in the Grotta di San Teodoro the sources of protein were wider, including aurochs' meat and probably an aquatic element (Mannino et al. 2011). Inter-individual dietary variation is suggested by isotope analyses of human remains from the Grotta del

Romito, Cosenza, Italy, where most individuals' protein sources were terrestrial herbivores but one had a significant river fish component (Craig et al. 2010).

A striking example of the use of pollen and plant macrofossil data in contexts where hunter-gatherers are usually envisaged as horse hunters derives from the Lateglacial in South West Germany, in a culturally Magdalenian context (Owen 2002). Owen's consideration of the distortion between the oft-visible faunal assemblages indicative of the hunting of terrestrial herbivores and the poorly-considered evidence of the use of small animals and plants indicated the 'extensive gathering and processing of plants' in the Magdalenian (Owen 2002, Tables 13.2–13.3). About a quarter of the edible plants and a quarter of medicinal plants present at Ezero were also found in the German Magdalenian sites analysed by Owen. The strongest overlap occurs in three plant food categories: tubers and roots, stems and shoots, and young leaves. Perhaps not surprisingly given its relatively northern latitude, far fewer seed-bearing plants and plants with fruits and/or nuts were available in South West Germany. But the occurrence of several species and even some sub-species of other potentially edible taxa in pollen diagrams from such diverse ecological zones strengthens the case for the actual use of these plants for dietary and medicinal purposes.

Indirect support for the use of such wild plant resources as were found at Ezero derives from the species lists of the two pollen diagrams developed as part of the Klithi Project – Gramousti Lake at 400 masl (Willis 1997) and Late Ziros at 50 masl (Turner, Sánchez-Goñi 1997). The Lateglacial levels of both diagrams indicated the presence of many of the plant taxa found at Ezero, although the representation of these plants is based upon pollen, and very few macrofossils were recovered. The same can be said of Bottema's (1974) pollen diagrams for Greek Macedonia, where a range of similar plant taxa to those found at Ezero was also recovered. In the recently published pollen diagram from the higher-altitude Lake Prespa, the sub-phase Prespa P-2b is contemporary with the Ezero Lateglacial sediments (Panagiotopoulos et al. 2013). Here, a grassy steppe where Poaceae far exceeded *Artemisia* and chenopods contained stands of trees which were *Pinus*-dominated with some mixed oaks and other thermophilous species. Many edible and/or medicinal plant taxa found at Ezero were also identified in Phase P-2b of the Prespa lake diagram. The Lake Prespa diagram confirms for a wide pollen catchment that a similar range of useful plant taxa were available in the West Balkans in the Lateglacial period.

More local parallels for the use of the plants recognised at Ezero are few and far between, with the Upper Palaeolithic plant remains recognised among a mixed terrestrial-marine diet at the Franchthi Cave, Peloponnese, Greece, a notable exception (Hansen 1991; Stiner, Munro 2011). Here, in the Zone II layers dating to c. 15000–12000 BC, a wide range of wild species was consumed, including barley, oats, lentils, bitter vetch, gromwell, pistacio, almond, pear, grape, hackberry and bedstraw (Hansen 1991, 110–117; Perlès 1999). Hansen links this expansion in use of wild species to the warmer and moister Lateglacial Interstadial.

The inference from their presence that plant foods would have been utilized by any Lateglacial hunter-gatherers present in the region is justified by the ethno-archaeological insight that contemporary hunter-gatherers have detailed knowledge of their plant environments (Mason, Hather 2002) and by the few direct examples of their presence on Lateglacial sites that exist. The ethnographic argument is based upon a wide range of studies of hunter-gatherer subsistence in differing contexts and periods, all of which recognise that, although the hunting of mammals, usually by adolescent and adult males, was an important activity, it usually did not contribute much to the total food requirements of the group,

at least in the temperate and tropical zones (Hillman et al. 1989). By contrast, the collection of plant resources on an often daily basis, usually by women and children, has often formed the economic basis for hunter-gatherer survival. These social practices were based upon, and contributed to, a deep knowledge of local ecosystems, and thus very high proportion of available plants was recognised, with their potential uses identified and brought into the local ethno-botanical stockpile of wisdom and skills.

Modern methods of pollen and macrofossil recovery, isotopic, residue and microwear analyses have revealed, therefore, that European Palaeolithic hunter-gatherer diets varied regionally, diachronically, and seasonally. The ubiquity of some exploitation of plants where indications of their presence survives should probably give us confidence that *where* and *when* they were present in the regional landscape they formed an integral part of the diet. Direct evidence of the processing of plant foods and medicines in the Lateglacial is scarce, however; evidence in the form of pollen or macrofossils usually documents presence only, and this does not automatically mean that taxa present were utilised. Bailey has wisely concluded as much: 'it is one thing to say that plant foods were *available*, quite another to say that they were *exploited* as foods, and quite another thing to infer from evidence of exploitation a *dependency* on plant foods as a major staple' (Bailey 1997, 664, our emphases). This argument is probably over-cautious, however, and it may be more useful to divide foragers' thinking about plants into four categories: 'availability yet ignorance'; 'availability and occasional use' (perhaps seasonal); 'availability and general use' and 'availability and reliance and/or intensive use'. The emphasis on well-preserved faunal assemblages would usually be taken to imply general use or reliance upon terrestrial herbivores in the Palaeolithic, although by the same argument one might conclude the same for plant resources given the apparent ubiquity in their exploitation where their remains survive. We therefore suggest that these points combine to make a strong case for Bailey's Stage 2 during the Lateglacial – the use of plants identified as present in the Ezero pollen diagram by a hypothetical breeding network of hunter-gatherers. The issue here, of course, is whether the current lack of evidence for human presence at Ezero in the Lateglacial reflects a real absence from this taxonomically rich Garden of Eden, or whether issues of preservation and recovery are at work. We now turn to this issue; what evidence do we have for Final Palaeolithic human presence in this region?

Upper Pleistocene and Lateglacial settlement of the Ezero region

The Lateglacial Final Palaeolithic of Southeast and Eastern Europe is poorly understood, sandwiched as it is between the more visible Upper Palaeolithic and the revitalised Mesolithic. The conditions of preservation on the few known sites have left lithic-dominated remains similar to those found on Upper Palaeolithic sites elsewhere in Europe (e.g. Gamble 1999a; papers in Bailey et al. 1999) although further information is generally lacking. For the Lateglacial, three ^{14}C dates from the Klithi Project demonstrate human activity in the period 16,000–14,000 cal BP – one from Klithi and two from the Boila rockshelter (Bailey 1997, 31, Table 2.2). There is otherwise a near absence of Lateglacial sites in the southern Balkans. There are three possible reasons for this: (1) the paucity of sites reflects the actual number of Final Palaeolithic settlements, i.e. humans were remarkably sparse in this large, southern geographical area; (2) the paucity of sites is due to a preservation bias (Chapman 1989), in which palaeoenvironmental changes differentially affected Final Palaeolithic valley settlements more clearly than cave sites (e.g. in the Rhodopes); or (3) the paucity of sites

is due to the lack of research on the relatively unloved eastern part of a period of European prehistory dominated by the striking cave art and artifactual floruit of Western Europe (Bahn 2007; Conneller 2010).

Despite a number of intensive, systematic surveys in Southeast Europe, very few traces of Final Palaeolithic flint discard have actually been identified (e.g. Hungary: Jankovitch et al. 1989; Chapman et al. 2003; Serbia – Vasiljević, Trbuhović 1972; Romania – Bailey et al. 2002; Dalmatia – Chapman et al. 1996). Even though these surveys developed active strategies for the identification of diagnostic Lateglacial lithics, results revealed disappointingly low frequencies of objects diagnostic of the Final Palaeolithic. There is clearly no sign of a plethora of obvious and well-defined Final Palaeolithic sites in the region (Kozłowski 2005). There has admittedly been little in the way of research targeted specifically at the Final Palaeolithic – usually referred to as the ‘Epigravettian’ – in Bulgaria and more widely in Greece, Anatolia and the Balkans. The several known sites in Bulgaria remain the open air sites in the Western Rhodopes belonging to the Final Epigravettian (Ivanova 1987), as well as the cave settlements of Temnata Cave (Ginter et al. 1994; Giourova, Schtchelinski 1994) and Kozarnika Cave (Guadelli et al. 2005). There are also cave sites in the Eastern Rhodopes, such as Arkata, and the caves of Golyama and Malka Leyarna in the Strandzha mountains (Ivanova et al. 2012), as well as the open-air site of Pobiti Kamani (Gatsov 1989). All of these fall outside a notional 120-km macro-territory of the Ezero area. A recent discovery on the island of Limnos, northeast Aegean, is the open-air lithic scatter of Ouriakos, with dates slightly later than Ezero falling in the Younger Dryas (Efstratiou et al. 2013). At present these few sites tell us little more than the fact that Final Palaeolithic groups were at least temporarily present in each region in the Lateglacial.

Nonetheless, we should recall the adage that the absence of evidence does not necessarily constitute evidence of absence. The preservational bias that Chapman (1989) sought to identify in the Balkans was the post-Mesolithic alluviation that has affected the landscapes of most major and many minor valleys in the Balkans. With such a process, any Final Palaeolithic and Mesolithic lithic scatter that formed on the floodplains of such river systems would have been preferentially buried in alluvium or slopewash from the impact of later farmers – a fate, by contrast, avoided by the majority of first-terrace-edge Neolithic settlements. A good example is the Teleorman valley in southern Romania, where considerable hydrological instability led to alluvial deposition during the Neolithic (Bailey et al. 2002). We can still agree with Obermaier’s (1924) observation that a human abandonment of a large part of Europe – Southeast Europe at that – just at the time of an environmental amelioration, would have been strangely illogical.

It is in this context that we must interpret the results from the Ezero core. We would think it remarkable if such a rich vegetal (and one therefore assumes, faunal) environment as Ezero was a human desert during the Lateglacial. The Ezero pollen diagram reveals the importance of an expanding grass steppe, with increased moisture availability, from 14 200 cal BP onwards (Magyari et al. 2008; *contra* Connor et al. 2013). These changing conditions would have increased the grazing capacity of the local territory, probably for caprovines rather than red or roe deer, and thus while it is clear that there was a far greater contribution of meat by weight to human diet in the Palaeolithic than fruits ($\times 3$) or young leaves ($\times 10$) the region must have been attractive in terms of both faunal and floral resources. If Lateglacial hunter-gatherers were present in this part of the Thracian Plain, locating their sites near the major source of fresh water – the Ezero lake – would have made sense in terms of the exploitation of this ecotonal area, notably the lake flora and water-birds, as well as those ru-

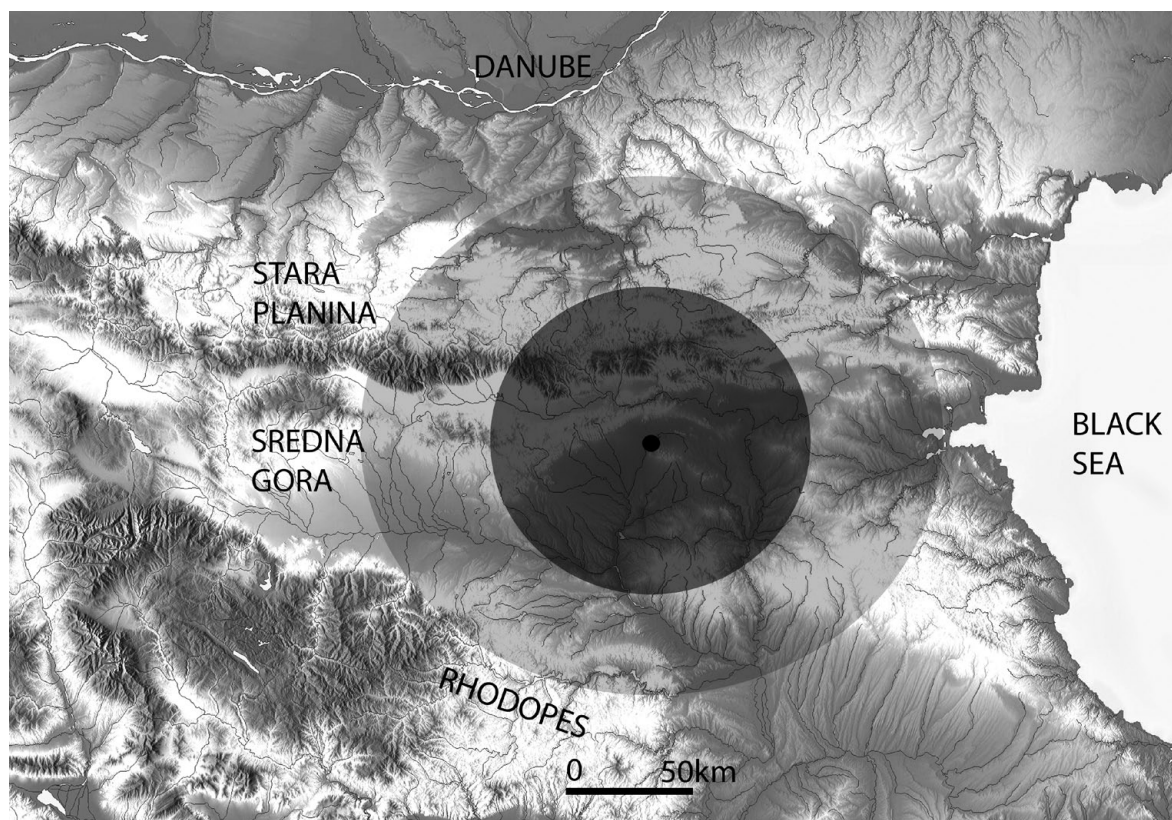


Fig. 6 Demographic modelling of hypothetical mating networks for Final Palaeolithic communities in the SE Balkans: Inner circle: postulated densities of 0.05 persons/km²; outer circle: postulated densities of 0.005 persons/km²

Обр. 6. Демографски модел на хипотетична 'брачна' мрежа на обществата през късния палеолит на юго-източните Балкани: вътрешен кръг: постулирана гъстота 0.05 души/км²; външен кръг: постулирана гъстота 0.005 души/км²

minants visiting the lake for water and fodder. While the seasonal range of available plants at Ezero covered spring, summer and autumn, there was probably no better site in which to spend the winter months, given the availability of rhizomes from reedmace in the winter. The winter shutdown was probably the most significant limiting factor in the sustainability of a long-term breeding network in the Upper Pleistocene of the region. Thus, a case could be made for the availability of sufficient broad-spectrum food resources to sustain a modest breeding network – perhaps somewhat higher than the network postulated for Epirus. On the basis of the Gramousti and Ziros pollen diagrams and the subsistence reconstruction of Klithi as an ibex-hunting group, Bailey (1997, 612) estimates that the total population in the eastern hinterland of Lateglacial Epirus was no more than 50 people. It should however be recalled that Klithi was occupied in a colder period than Ezero and at higher altitudes.

What form would such a breeding network take? Wobst's modelling of hunter-gatherer breeding networks sought an answer to the question 'how large does an exogamous mating network have to be to ensure that any member, upon reaching maturity, will find a suitable mate?' (Wobst 1976, 50; cf. 1974; 1975). Wobst found that the practical lower limit for a network with long-term viability was 475 people. Given the range of modern hunter-gatherer population densities of between 0.5 to 0.005 persons/km², Wobst calculated the areal extent of the network as 950 km² at a density of 0.5 persons/km², up to 95,000 km² for a density of 0.005 persons/km². There is little likelihood of an accurate estimate of a Final

Palaeolithic population density anywhere in the Balkans (for an attempt to model mating networks for the Iron Gates Mesolithic, see Chapman 1989) but a start may be made by exploring the network size in the medium density range – viz., 0.05km², or one person every 20 km² (Fig. 6: inner circle). A network size of 9,500 km² could include large parts of the Thracian Plain (an area of 6,000km²) as well as the Sredna Gora range and the southern slopes of the Stara Planina range to the North but not the Rhodopes to the South. Given the absence of any Final Palaeolithic (Epigravettian) sites in this inner mating territory, we might therefore hypothesize a large but very low-density network of hunter-gatherers operating over a large area of the Southeast Balkans, including major lowland and upland components. Structuring such a 'long distance, highly-mobile network seasonally could have helped to avoid the winters in the Stara Planina, focussing instead on ecotonal hotspots with greater resource concentrations in other seasons, such as the Ezero lake. If population densities fell below the 0.05 persons/km² level, the increased areal extent of the network would have included much of the eastern and central parts of the Stara Planina, all of the Thracian Plain and the northern parts of the Rhodopes (Fig. 6: outer circle). If, however, the number of people in the mating network fell below the minimum size of 475 individuals, its long-term viability would have been threatened, leading to the periodic collapse of the mating network. This perspective provides a broader spatial context to the settlement patterns of hunter-gatherer communities who may have been exploiting the lowland environments of the Thracian Plain. The paucity of known sites from this period may well imply a low level of mating network development, with local collapses and re-occupations more common than in successive stages of the Holocene. Viewed in this light, it may be optimistic to expect to sample Lateglacial archaeological sites in the region.

A last point concerns the use of medicinal plants at Ezero. Archaeology has gained immense benefits from a number of wide-ranging research programmes into palaeopathology (Roberts 2011; Roberts, Manchester 2005) but less attention has been paid to those plants that could have helped people to recover from conditions, infections and traumas. Now that Neanderthals are recognised to have used medicinal plants (Hardy et al. 2012), one can surely assume that members of our own species in the Lateglacial equally benefitted from this form of ecological knowledge, and this pertains as much for the Ezero material as for elsewhere. A far-flung comparison from the earliest documented Palaeo-Indian site in the New World – Monte Verde, Chile, where the occupation is by chance coeval with the Ezero diagram – reveals that the local Indian population currently uses **all** of the eighteen plant species recovered from hearths inside the prehistoric campsite for medicinal purposes (Adovasio et al. 2007, 224–225). A total of 27 plant taxa found at Ezero has recent or current evidence for medicinal properties, covering a wide range of conditions, including toothache, skin conditions, diarrhoea and haemorrhoids. By-the-by, the rarity of medicinal properties in the wild cereals makes the point that increasing specialisation on cereals would probably have reduced contact with medicinal plants for most of the people in a food-producing community, perhaps leading to specialised practices of healing for certain individuals.

Conclusions

In this paper, we have investigated the implications of the wide range of plant remains, recovered as both pollen and macrofossils, from the earlier part of the Ezero-2 core, dating to the period 15500–13500 BP. We have reached four principal conclusions about the interface between the palaeo-environment of these cold periods and the potential social

networks of hunter-gatherers who may have occupied the Maritsa Basin and the South Thracian Plain at this time but who are so elusive archaeologically.

First, the pollen and macrofossil records together reveal the presence of a range of arboreal and shrubby taxa which complemented and diversified the otherwise semi-desertic or grass steppe of these periods. It is now clear that the notion of a largely or completely treeless steppic zone in Southern Europe at the end of the last Ice Age cannot be maintained. Instead, patches of trees and groups of shrubs suggest a more diverse, more productive landscape, with a tendency towards a forest steppe. It remains unclear whether these arboreal species were present in the South Thracian Plain, as a Late Pleistocene refuge zone or whether there was an expansion of arboreal species from Anatolia (Magyari et al. 2008).

Secondly, the landscape of the Thracian Plain was clearly diversified during the Late Pleistocene, within which the Maritsa and Azmak rivers could have provided significant food resources and the presence of the Ezero lake could have acted as a focus of special resources, including many lacustrine species that were available for food or for medicinal usage.

Thirdly, the case has been made that not only was a wide range of plant taxa present in the Ezero local area in the Late Pleistocene but that most of the documented plants, if not all of them, were used by human populations, without any likelihood of developing special reliance on any individual taxa. The implied food-collecting strategy is clearly a broad-spectrum approach, where the lack of a single, or two, main resource species, is compensated by a diversity of taxa. There is also a strong probability that many of the plant taxa were exploited for their medicinal potential.

The fourth conclusion is that the Ezero plant taxa could have supported subsistence over at least three seasons of the year – spring, summer and autumn – during which time they could have made a major contribution to the food quest for a local social network, who also could rely, at least from 14200 BP onwards, on a grassier steppe with a higher ruminant carrying capacity than was available in the Upper Pleistocene landscape. The speculation is that the Ezero breeding network was rather more numerous than the total of 50 persons which Bailey (1997) has proposed for the Lateglacial period in Epirus, largely because the Thracian Plain is lower and the period warmer than the Klithi occupation. It is hypothesised that the breeding network would have stood a better chance of long-term success after 14200 cal BP, with the heightened carrying capacity of the grassy forest-steppe. The only coping methods for the long-term threat to the Thracian Plain breeding network – the winter shutdown – were food storage and the need for plant products that were indeed storable. There is currently little evidence for either of these in the period 15500–13500 cal BP in the South Balkans, but the Ezero core reminds us of the varying group size and subsistence strategies that presumably pertained in Lateglacial Europe, and that not all of them will be easy to detect archaeologically. The alternative – that humans really were absent from this vegetal Garden of Eden – would be remarkable.

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Палео-екологична среда през късноледниковия период на Балканите и възможностите, които тя предлага – отсъстват ли хората от 'Райската градина'?

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(резюме)

Долната част на поленовата колонка взета от езерото до Дипсизката селищна могила (известна като селищна могила Езеро) в Горнотракийската низина в България обхваща периода 15 500–11 000 cal BP (Гренландски ледников период G1-1C-1E). Наличието на растителни макрофосили, както и на поленов пращец в тази част на колонката са сигурен индикатор, че растителната покривка в този период се е състояла от храсти, дървета и богата влаголюбива флора, а не както се смята сега – от предимно обезлесена тревисто-степна растителност. Археологически, етнографски и етно-исторически изследвания на над 70 растителни вида показват, че 20 вида имат документирана употреба като храна, 13 като лечебни средства и 14 вида са се употребявали както за препитание, така и за лечение. Нещо повече, няколко вида са били използвани или присъстват в синхронни обекти в югозападна Германия и пещерата

Франкти в Гърция. Статията защитава предположението, че към финала на късния палеолит обществата в Горнотракийската низина биха могли да се възползват от такъв богат запас на хранителни и лечебни растения. В същото време са налице редица причини – дали тафономични, дали научно-изследователски или пък педагогични – които обясняват липсата на археологически обекти от финала на късния палеолит в Горнотракийската низина.